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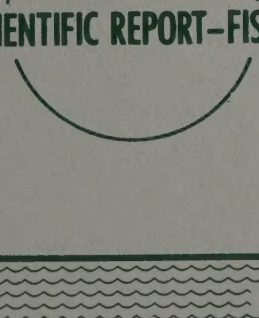

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SPRING CHINOOK SALMON TRANSPLANTATION STUDY
1955-61

by

Paul D. Zimmer, Roy J. Wahle, and Eugene M. Maltzeff

United States Fish and Wildlife Service
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ABSTRACT

A study to determine feasibility of introducing spring chinook salmon into Wind River, Washington, has been underway since 1955. In the period 1955-61, 3,221 adult spring chinook salmon have been trapped at Bonneville Dam on the Columbia River and transferred to Carson National Fish Hatchery at Wind River, Washington, for subsequent artificial propagation. The total number of fingerlings released in Wind River, resulting from artificial spawning of adults hauled from Bonneville Dam and from adults returning to the hatchery, has been 5,078,800.

Partial counts in 1956, 1957, and 1958 at Shipperd Falls fishway, located on Wind River near its mouth, indicate that 10, 1, and 26 spring chinook salmon, respectively, passed through the fishway. Counting was not conducted in 1959. Full-time counting was conducted in 1960 and 1961 at Shipperd Falls fishway and totals of 854 and 1,032 spring chinook salmon, respectively, were tabulated.

Spring chinook salmon adults returning to Carson National Fish Hatchery from releases of fingerlings have been as follows: 1959, 107; 1960, 552; 1961, 610.

INTRODUCTION

Many attempts have been made to introduce new runs, or to increase existing populations, of spring chinook salmon *(Oncorhynchus tshawytscha)* not only in the Columbia River watershed, but in coastal streams of Oregon and Washington as well. Inadequate facilities to hold fish during maturation period, unfavorable water temperatures for the adults, inability to secure eggs of good quality, and difficulties in rearing young salmon to fingerling size have been responsible for negligible success in most instances.

A major function of the Columbia River Fishery Development Program of the Bureau of Commercial Fisheries, U.S. Fish and Wildlife Service, is the improvement of natural stream habitat by removal of log jams and construction of fishways at natural barriers. These activities have made many additional miles of spawning and rearing area available to anadromous fish.

Wind River in Washington has been improved by stream clearance and fishway construction. A joint effort of the Bureau of Sport Fisheries and Wildlife and the Bureau of Commercial Fisheries is now underway to bring this stream into full salmon production. To accomplish this, 500 adult spring chinook salmon have been trapped each year since 1955 at Bonneville Dam and transferred to Carson National Fish Hatchery, on Wind River. Carson hatchery is located approximately 20 miles upstream from the recently constructed fishway at Shipperd Falls. Eggs for artificial propagation are taken from the fish hauled from Bonneville Dam and from adults returning to the hatchery, and the resulting fingerlings reared for 1 year and released in Wind River. This project provides an opportunity to determine whether the transfer of nonindigenous and heterogeneous stocks of adult spring chinook salmon to a new watershed is a satisfactory method for establishing a run of fish that will be self-perpetuating in its new environment.

Complete success or failure of this transfer of spring chinook salmon from Bonneville Dam fishways to Wind River will not be known until at least several cycles of fish have returned to that river.

The present program of transferring adult spring chinook salmon from Bonneville Dam to Carson hatchery is scheduled for completion in 1965, at which time a more complete evaluation of the project will be made. This progress report has been prepared so that other fishery workers considering such methods of transferring runs of salmon may profit from the data available to date.

EARLY ATTEMPTS TO INTRODUCE SPRING CHINOOK SALMON INTO WIND RIVER

Several early attempts were made to introduce spring chinook salmon into Wind River, but with little success. Releases of young fish were as follows: 1938, 91,700; 1939, 91,700; 1940, 96,500; and 1953, 7,600. The first three groups of fish were from eggs of spring chinook salmon taken from the Clackamas River in Oregon. The fingerlings released in 1953 were from eggs provided by a Willamette River hatchery operated by the Fish Commission of Oregon. Incubation and rearing of all groups were at Carson hatchery. Apparently these efforts were not successful, as no fish were observed returning as adults. In 1943 and 1944, attempts were made with summer chinook salmon trapped at Bonneville Dam. Eggs were incubated and the young reared at Carson hatchery and released into Wind River. As in other years, fish from these releases were not reported to have returned as adult spawners. Chinook salmon passing Bonneville Dam March 1 to May 31 and June 1 to August 15 are considered spring and summer fish, respectively (U.S. Army Engineer Districts, Portland and Walla Walla, 1960[1]).

In 1945, approximately 35,000 spring chinook salmon eggs were transferred from Camas Creek, Idaho, to Carson hatchery for incubation and subsequent rearing. At release time in October 1946, approximately 20,500 fingerlings were released into Wind River. All fish were marked by excision of fins. In 1949, 21 adult spring chinook salmon were observed in Wind River below Shipperd Falls. Four carcasses recovered at end of spawning were marked fish released in 1946.[2] This was the first tangible evidence that upriver stocks might lend themselves for transfer to lower river areas.

PRESENT PROGRAM

Material included in this report pertains to the period 1955-61, and reports on trapping and hauling; artificial propagation, which includes holding and spawning of adult salmon, incubation of eggs, rearing of fingerlings, and disease treatment; and enumeration of returning adults.

[1] U.S. Army Engineer Districts, Portland and Walla Walla. 1960. Annual Fish Passage Report, North Pacific Division; Bonneville, The Dalles, and McNary Dams; Columbia River, Oregon and Washington. U.S. Army Corps of Engineers, Engineer Districts, Portland and Walla Walla, 53 p., 102 tables, 27 plates, 3 maps, 5 photos.

[2] Zimmer, Paul D., 1950. Observations of 1949 return of the experimental transfer of chinook salmon from Camas Creek, Idaho, to Wind River, Washington. Fish and Wildlife Service, February 1950, unpublished report, Portland, Oreg.

Activities in 1954 were of a facility testing nature, and only a limited number of summer-run chinook salmon were trapped at Bonneville Dam and taken to Carson hatchery. The spring chinook salmon transplantation program did not actually begin until 1955.

Trapping and Hauling

Salmon used in the present study are trapped at Bonneville Dam, located on the Columbia River about 150 miles above the mouth (fig. 1). Trapping facilities are located at the exit of Washington shore fishway (fig. 2).

Each year, preceding regular operations, a trial run is made of the entire trapping and hauling procedure. This serves as a checking and testing operation for the truck drivers and trap operator, and permits any necessary adjustments to mechanical and electrical functions of the trap. After being loaded into the 1,000-gallon tank truck, fish are transported to the hatchery, where they are released into a dirt holding pond (fig. 3). Truck travel time from Bonneville Dam to Carson hatchery is approximately 1 hour.

Data pertaining to trapping operations in period 1955-61 are given in table 1. Numbers of fish hauled in individual loads have varied from 20 to 74, and no noticeable adverse effects could be detected as a result of hauling the larger numbers of fish. Hauling mortalities experienced during each year of operation are given in table 2. On one occasion mechanical failure of the truck resulted in several hours' delay while fish were in transit. No ill effects to the fish were observed.

Water temperatures have not been a problem during hauling operations. Water for the truck tank is provided from Bonneville pool, and for years 1955-61 the temperatures have been in the lower 50° F. During the period of early spring hauling, air temperatures have been low, and no greater than a 2° F. increase in water temperature in the truck tank has occurred while fish were being transferred to the hatchery.

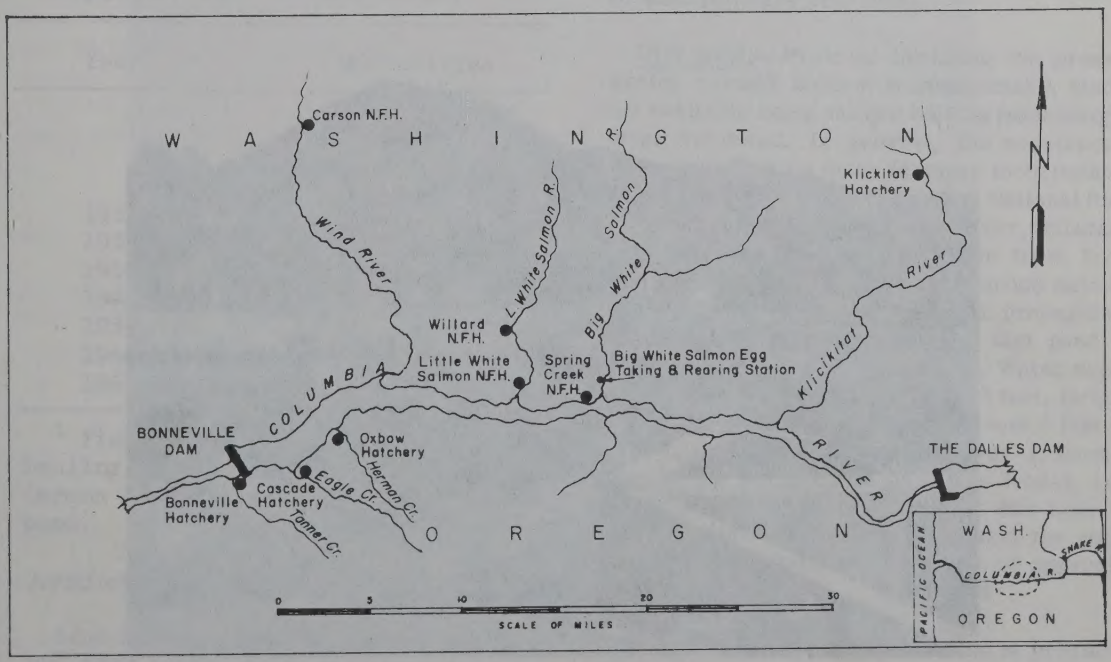

Figure 1.--Columbia River, Bonneville Dam and vicinity.

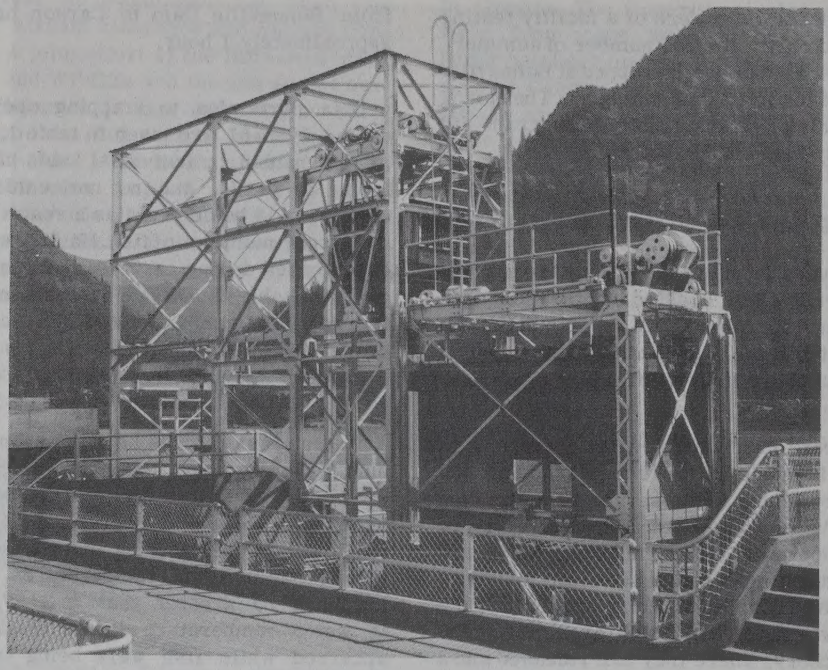

Figure 2.--Trapping facilities, Washington shore fishway, Bonneville Dam.

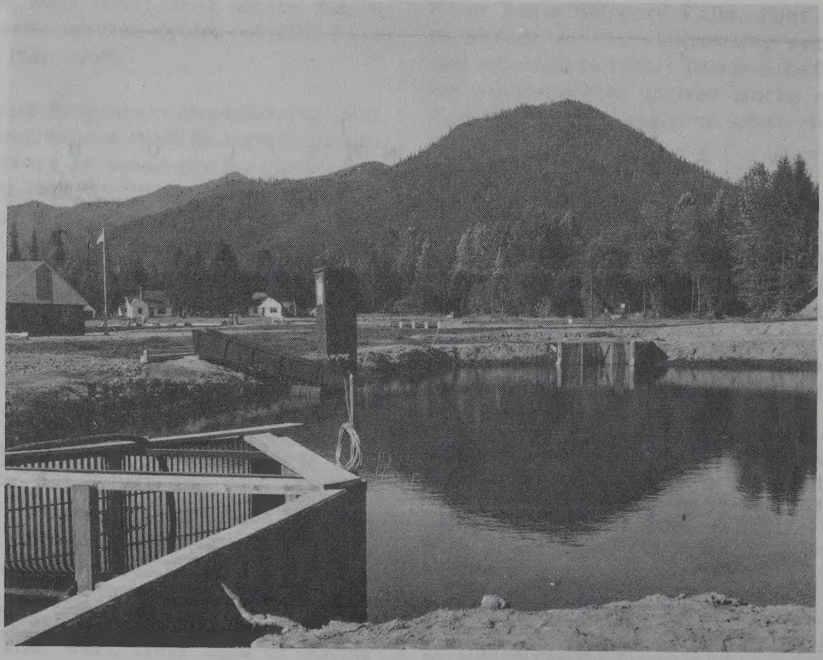

Figure 3.--Dirt holding pond for adult salmon, Carson National Fish Hatchery.

Table 1.--Adult spring chinook salmon trapped at Bonneville Dam and transferred to Carson National Fish Hatchery, 1955-61.[1]

Year	Bonneville Dam annual count[2]	Period of trapping	Days of trapping	Total trapping-period count (Washington shore fishway only)	Fish transferred to Carson hatchery			
					Male[3]	Female	Total	Trapping-period count
	Number of fish		Number	Number	Number	Number	Number	Percent
1955	171,596	4/19-22, 25, 27	6	28,007	161	356	517	1.85
1956	63,449	5/4-8	5	7,595	228	270	498	6.55
1957	136,440	4/22-26	5	8,111	192	234	426[4]	5.25
1958	75,206	5/1-3, 5, 6	5	4,870	164	360	524[5]	10.76
1959	61,133	4/27-5/1, 4, 11-15	11	10,740	94	90	184	1.71
1960	69,597	4/26-5/1	6	7,334	237	290	527	7.19
1961	98,705[6]	4/17-22	6	1,993	252	293	545[7]	27.30

[1] Data on numbers of fish handled taken from hatchery records.
[2] Data from annual reports, U.S. Army Corps of Engineers.
[3] Included are small chinook salmon, 16-18 inches in length, usually identified as jack salmon or grilse.
[4] Includes 62 fish held in concrete pond.
[5] Does not include 3 fish which died in truck.
[6] Unpublished data.
[7] Does not include 4 fish which died in truck.

Table 2.--Hauling mortalities, adult spring chinook salmon, Bonneville Dam to Carson National Fish Hatchery, 1955-61.[1]

Year	Mortalities
	Number of fish
1955	0
1956	0
1957	0
1958	3
1959	0
1960	0
1961	4

[1] Fish considered as mortalities in hauling were those dead on arrival at Carson National Fish Hatchery holding pond.

Artificial Propagation

Adult holding and spawning.--Availability of two adult holding ponds at Carson hatchery, one of concrete and the other of dirt, has permitted a comparison of the two different facilities for retaining fish until they reach sexual maturity. Data pertaining to operation of each pond are presented.

Dirt pond.--Prior to initiating the present spring chinook salmon transplantation study, all available adult salmon holding pond designs were reviewed. In general, the constructed dirt pond contains many features incorporated in the holding facilities at Entiat National Fish Hatchery, located on the Entiat River, tributary to the Columbia River, upstream from Rock Island Dam. At this hatchery chinook salmon are currently held for artificial propagation purposes. Surface area of the dirt pond is approximately 7,500 square feet. Water depth is maintained at approximately 5 feet. Originally, the pond varied in depth from 5 feet to 2 feet, the sides were sloped 2-on-1, from 2 feet to the surface the slope was 3-on-1, and above the water surface the slope was 1-on-1. Due to bank slippage and erosion the pond sides have stabilized at a slope of approximately 3-on-1.

Water for the dirt holding pond is provided from two sources: Tyee Springs and Wind River. Daily maximum and minimum temperatures of

the water in the dirt pond are given in Appendix tables A-1--A-7. Because of its cooler temperature, it is customary to utilize Tyee Springs water for most of the holding period, and to introduce warmer Wind River water to hasten maturation in late summer. Water from both sources is mixed before being introduced through a submerged diffusion chamber at the upper end of the pond. A trap to capture fish for collection of eggs is installed upstream from the diffusion chamber. As the spawning season approaches, additional water is introduced for attraction into the trap. Most of the salmon move into the trapping facility of their own accord; however, each year, near the end of the egg-taking operations, it has been found necessary to capture, by seining, those fish that try to spawn in the pond. In earlier years, when seining was not done, some of the fish spawned in the pond, with a subsequent loss of eggs. No deleterious effects have been observed from such seining operations. Data pertaining to fish that have spawned in the pond are given in table 3.

Length measurements are taken of all fish handled. In addition, data are recorded regarding disease, injuries, and condition of eggs.

An inclined-plane screen trap located at the pond outlet has been provided to capture any adult scrap fish, largescale suckers *(Catostomus macrocheilus)* and Northern squawfish *(Ptychocheilus oregonensis)*, transported in the loads of fish from Bonneville Dam or young fish resulting from their spawning in the pond. At the close of the salmon spawning operation, the pond is drained and all scrap fish present are removed and destroyed.

In 1954, a few summer chinook salmon were hauled from Bonneville Dam and placed in the dirt holding pond at the Carson hatchery to determine optimum flows required and proper method of introducing Wind River water into the facility. Data collected have formed the basis for present operations.

Flows of water in the pond have varied from 11 to 19 cubic feet per second (c.f.s.). It has been determined by studying the reactions of the fish that a flow of about 14-15 c.f.s. is most desirable for holding the adult spring chinook salmon at Carson hatchery. In introducing Wind River water into the pond to hasten maturation, it was found necessary to make gradual additions of the warmer water. When Wind River water was introduced too quickly, the fish became very agitated, and in some instances swam out of the water and up on the banks. Considerable jumping also occurred.

To date, fish held in the dirt holding pond have not developed fungus to any serious degree. This has not been the case, however, with adults held in the concrete holding ponds.

Table 3.--Records of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, 1955-61.

Year	Total fish	Dead in trap or pond		Losses of female fish			Total losses		Loss	Period of retention	Pond flow	Water temperature	
		Male[1]	Female	Spawned in pond	Killed in error (unripe)	Diseased ovaries	Male	Female				Max.	Min.
	Number	Number	Number	Number	Number	Number	Number	Number	Percent		c.f.s.	Degrees F.	
1955	517	28	44	26	4	0	28	74	19.7	4/19-9/23	11-19	58	40
1956	498	42	32	17	1	0	42	50	18.5	5/4-9/20	13-16	59	39
1957	364	69	24	15	1	1	69	41	30.2	4/22-9/30	14-16	61	39
1958	524	29	60	4	8	0	29	72	19.3	5/1-9/25	14-19	59	39
1959	184[2]	13	5	6	1	0	13	12	13.6	4/28-9/22	16-19	56	40
1960	527	25	35	9	0	3	25	47	13.7	4/26-9/27	13-19	--	--
1961	545[3]	14	10	11	1	1	14	23	6.8	4/21-10/2	13-19	55	40

[1] Includes jacks.
[2] Does not include 3 fish which died in truck.
[3] Does not include 4 fish which died in truck.

Discussion of the problems encountered in holding adults in the concrete pond at Carson hatchery is presented later in this report.

Data pertaining to losses of fish held in the dirt holding pond in period 1955-61 are given in table 3 and Appendix tables A-1--A-7.

Greatest loss of fish held in the dirt holding pond occurred in 1957--30.2 percent. This was the year of highest water temperatures (table 3).

Eggs collected from adults held in the dirt holding pond have varied from 330,700 in 1959, when 184 fish were transferred from Bonneville Dam, to 1,259,300 in 1961, when 545 fish were transferred to Carson hatchery.

Information regarding losses during incubation of eggs and rearing of fingerlings is given in table 4.

Concrete pond.--The concrete holding pond at Carson hatchery is used as a ripening area for those adult spring chinook salmon that return to their point of release (fig. 4). The pond is 146 feet long and 40 feet wide, with concrete sides and bottom. Normal depth of water in the pond during the salmon maturing period is 3.5 feet. Water from Tyee Springs is introduced through a diffusion chamber located on the bottom near the upper end of the pond. When needed, additional flow is introduced from Wind River. Water from the fingerling rearing ponds also passes through the adult holding ponds. Daily maximum and minimum temperatures of the water in the pond are available for 1961 (Appendix table A-9).

In 1957, 62 spring chinook salmon trapped at Bonneville Dam were held in the concrete holding pond at the hatchery (table 5). Of this number, 15 fish (24.2 percent) died in the trap or pond, were killed before sexually mature, or had diseased ovaries. In this same year, 364 fish were held in the dirt pond, and similar losses amounted to 110 fish (30.2 percent).

In 1959, 107 chinook salmon entered the concrete holding pond from Wind River (table 5).

Table 4.--Losses incurred during artificial rearing of spring chinook salmon resulting from spawning of adults held in dirt holding pond, Carson National Fish Hatchery, 1955-61.

Brood year	Spawning period	Eggs taken	Mortality, green egg to eyed egg	Mortality, eyed egg to release	Total mortality, green egg to release	Fish released in Wind River	Release date
		Number	Percent	Percent	Percent	Number	
1955	8/10-9/23	1,256,000	10.6	12.2	22.0	911,700	10/17/56
	8/10-9/23		10.6	15.5	26.1	55,600	4/17/57
1956	8/9-9/20	907,000	7.2	24.1[1]	31.3	623,000	3/24/58
1957	8/11-9/30	1,024,000[2]	3.6	24.8[1]	28.4	732,800	4/ 9/59
1958	8/10-9/25	1,266,900	4.2	15.6[3]	19.8	1,016,500	4/15/60
1959	8/14-9/22	330,700	2.9	18.3	21.2	260,700	4/14/61
1960	8/8-9/27	856,700	2.9	12.5[4]	15.4	605,800	4/13/62
1961	8/11-10/1	1,259,300	3.6	--	--	--	--

[1] Includes losses in fingerlings partially reared at Little White Salmon and Willard hatcheries.
[2] Includes eggs taken from fish held in concrete pond.
[3] Rearing losses of the 50,000 unfed fry shipped to Happy Valley Reservoir not included.
[4] Rearing losses of the 75,300 unfed fry transferred to Happy Valley Reservoir not included. Rearing losses of the 56,900 fingerlings provided for Bonneville Dam experiments are included.

Figure 4.--Concrete holding pond for adult salmon, Carson National Fish Hatchery.

Table 5.--Records of adult spring chinook salmon held in concrete holding pond, Carson National Fish Hatchery, Wind River, Washington, 1957, 1959-61.

Date	Fish hauled to hatchery		Fish entering pond		Total fish in pond		Dead in pond or trap.		Losses of female fish			Total losses		Loss	Period of retention	Pond flow	Water temperature	
									Spawned in pond	Killed in error (unripe)	Diseased ovaries						Max.	Min.
	M.	F.	M.	F.	M.	F.	M.	F.				M.	F.					
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	Percent		c.f.s.	Degrees F.	
1957[1]	23	39	0	0	23	39	11	3	1	0	0	11	4	24.2	--	--	--	--
1959	0	0	105	2	105	2	0	2	0	0	0	0	2	1.7	--	--	--	--
1960[2]	47	17	221	331	269	348	17	15	3	3	8	17	29	13.4	5/5-9/22	12-14	--	--
1961	0	0	468	141	468	141	48	7	1	3	0	48	11	10.3	5/10-9/22	12-14	57	42

[1] Trapped at Bonneville Dam.
[2] 47 males and 17 females trapped at Little White Salmon National Fish Hatchery.

First fish arrived on May 21. Of the season's total of 107 fish, 99 were reported as jacks, 2 were females, and the remainder mature males. Of the 107 fish entering the pond, 2 fish (1.7 percent) died prior to spawning. In this same year, 184 fish were held in the dirt pond and losses were 25 fish (13.6 percent).

In 1960, first spring chinook salmon entering the concrete pond at Carson hatchery arrived on May 5. Shortly thereafter areas of fungus were observed on some of the fish. To retard further development of fungus, the fish in the concrete pond were treated with malachite green at the rate of 1 : 1,000,000 on the following dates: July 27, August 5, 8, 10, 12, 15, 22, 24, and 26. Observations indicated that development of fungus was apparently checked, and in some cases the infected areas healed over. In all, 552 salmon entered the concrete pond (table 5). Of the 552 fish, 331 were females, 170 males, and 51 jacks. Daily mortalities are given in Appendix table A-8.

Spawning of fish held in the concrete pond in 1960 began on August 4, as compared to August 8 of those held in the dirt pond. Termination of egg taking from adults in the concrete pond occurred on September 22, and in the dirt pond on September 27. On August 29, 1960, 47 male and 17 female spring chinook salmon were hauled from Little White Salmon hatchery and placed in the concrete holding pond at Carson hatchery. Mixing these two groups of fish together prevented keeping a separate record of those fish swimming into the pond. Total losses occurring during the holding period amounted to 13.4 percent as compared to 13.7 percent in the dirt pond.

Information regarding incubation of eggs and fingerlings reared is given in table 6.

Mortalities occurring during ripening period of those salmon which swam into the concrete pond at Carson hatchery in 1961 are given in table 5. First fish entered the pond on May 10, as compared to May 5, 1960. Spawning began on August 16 and ended September 16. In all, 141 females, 142 males, and 326 jacks appeared at the hatchery in 1961. Losses amounted to 10.3 percent as compared to 6.8 percent in the dirt pond. Daily mortalities in the concrete holding pond are given in Appendix table A-9. Slightly higher water temperatures occurred in the concrete pond than in the dirt pond in 1961. This may or may not be the reason for the difference in losses of fish. As in 1960, it was necessary to treat the fish with malachite green to retard fungus development.

Table 6.--Losses incurred during artificial rearing of spring chinook salmon resulting from spawning of adults held in concrete holding pond, Carson National Fish Hatchery, 1957, 1959-61.

Brood year	Spawning period	Eggs taken	Mortality, green egg to eyed egg	Mortality, eyed egg to release	Total mortality, green egg to release	Fish released	Release date
		Number	Percent	Percent	Percent	Number	
1957	8/11-9/30	--[1]	--	--	--	--	4/9/59
1959	--	0[2]	--	--	--	--	--
1960	8/4-9/22	1,020,300[3]	4.3	10.7	15.0	872,700	4/13/62
1961	8/16-9/16	429,700	4.5	--	--	--	--[4]

[1] Eggs taken were included in spawning operations in dirt holding pond.
[2] Of 107 adults returning to concrete holding pond in 1959, 2 were females and both died prior to spawning.
[3] Includes eggs taken from fish transferred from Little White Salmon hatchery.
[4] Fish to be released in spring of 1963.

As in the case of fish hauled from Bonneville Dam and held in the dirt pond, length measurements are taken and data recorded regarding disease, injuries, and condition of eggs.

Rearing Program

Diets.--Artificial rearing of spring chinook salmon has been undertaken at many locations, with varying degrees of success. Disease and/or dietary deficiencies are thought to be the major causes of poor results.

Various diets have been fed spring chinook salmon reared at Carson hatchery. Because of the many changes in specific items and quantities of each component used, it is impossible to correlate effect of any one diet or ingredient with success or failure of a given year's rearing program. Disease problems encountered further confuse the picture. Perhaps at conclusion of the transplantation program it may be possible to correlate adult returns with the fingerling feeding program and incidence of disease. At the present time the young spring chinook salmon are first fed the conventional "wet feed". When the fish have reached approximately 300 per pound, they are fed a commercially prepared dry feed.

Losses occurring during the rearing program are given in tables 4 and 6.

Disease problems and treatment during rearing period.--The 1,256,000 1955 brood-year spring chinook salmon at Carson hatchery were infected with kidney disease, two apparent virus diseases, white spot, infections of acid-fast bacteria, Myxosporidia, *Trichodina hexamite*, and several other external parasites. By August 1956 many fish were light-colored and popeyed. Ponds were treated with Sulfamerazine and Gantrisin, but no reduction in mortalities could be detected. Since it was impossible to curtail the losses, 911,700 fish were released in early October. The remainder were retained for over-winter rearing. Mortalities were experienced through the winter, and in April 1957 the remaining fish (55,600) were released. In subsequent years kidney disease has been the worst disease problem encountered. Treatments with Sulmet at 1- or 2-gr. level (1 or 2 grams of Sulmet per 100 pounds of food fed), however, appeared to check the infection. At first evidence of external parasites Pyridylmercuric acetate has been used, with excellent results.

Fry resulting from eggs collected from adult spring chinook salmon returning to Wind River in 1960 displayed symptons of coagulated yolk disease. This was also true of fry resulting from eggs taken from adults trapped at Bonneville Dam in the same year.

Samples of adult spring chinook salmon trapped at Bonneville Dam and of those returning to Wind River have been examined for acid-fast bacteria (tables 7 and 8).

Counting at Shipperd Falls Fishway

The Shipperd Falls fishway trap was in operation intermittently during 1955-58 (fig. 5). First spring chinook salmon recorded was in 1956, when 10 fish were observed (table 9). In 1957, one fish was observed. First returns of 1955 brood-year fish were expected in Wind River in 1958 as 3-year-old fish. In this year spot counting was done by Washington Department of Fisheries and 26 fish were recorded (fig. 5). There were numerous reports of sportsmen catching 3-year-old spring chinook salmon above and below Shipperd Falls fishway in 1958; however, there are no reliable data upon which to calculate total return of this group of fish. None of the fish returning in 1958 entered the Carson hatchery ponds.

Counting at Shipperd Falls fishway was not conducted in 1959. There were, however, reports of spring chinook salmon caught in Wind River above the falls. Full-time counting was conducted at the fishway in 1960 and 1961, and 854 and 1,032 fish, respectively, were recorded.

Spawning Ground Surveys of Wind River

Because of the reported poor condition of 1955 brood-year fingerlings, there were no surveys conducted in 1958, when adults would first return as 3-year-old fish. The count of 26 salmon at Shipperd Falls fishway indicated that some fish did return.

Table 7.--Incidence of acid-fast bacteria in adult spring chinook salmon trapped at Bonneville Dam and transferred to Carson National Fish Hatchery, 1956-60.[1]

Year	Fish examined	Sample	Infected	
	Number	Percent	Number	Percent
1956	66	13.3	0	0
1957	426	100.0	57	13.2
1958	50	9.5	7	14.0
1959	44	23.9	0	0.0
1960	500	94.9	1	0.2
1961	106	19.3	1	0.9

[1] Examinations of fish in 1956, 1957, and 1958 were by Western Fish Disease Laboratory, Seattle, Wash., and in 1959, 1960, and 1961 by Richard G. Bigej and Harlan E. Johnson, biologists, Bureau of Sport Fisheries and Wildlife, Little White Salmon National Fish Hatchery.

Table 8.--Incidence of acid-fast bacteria observed in adult spring chinook salmon of Carson National Fish Hatchery releases returning to Wind River, Washington, 1959-61.

Year	Examined	Sample	Infected	
	Number	Percent	Number	Percent
1959	79	73.8	0	0.0
1960	607[1]	98.4	49	8.1
1961	121	19.8	9	7.4

[1] Includes 65 fish transferred from Little White Salmon National Fish Hatchery.

Figure 5.--Shipperd Falls fishway.

In 1959, prior to the start of the fall chinook salmon spawning activity, surveys were conducted of Wind River to determine distribution of spring chinook salmon resulting from releases of 1955 and 1956 brood-year fingerlings. In the river below the hatchery 26 jack chinook salmon were observed. There were no large 4-year-old fish of 1955 brood-year observed.

Surveys in 1960 revealed 34 live fish and 107 redds downstream from the hatchery. In the area upstream from the hatchery 8 live fish and 19 redds were observed.

Table 9.--Count of spring chinook salmon, Shipperd Falls fishway, 1954-61.[1]

Year	Fish counted	Period of counting
	Number	
1954	0	September (incomplete count)
1955	0[2]	September-October (incomplete count)
1956	10	April-November (incomplete count)
1957	1	June-October (incomplete count)
1958	26	May-September (incomplete count)
1959	--	No count
1960	854	May 10-October 22
1961	1,032	April 2-November 29

[1] Salmon passing through Shipperd Falls fishway prior to August 15 are considered spring chinook.

[2] Fishway completed late in season. No counting conducted during period of spring chinook salmon migration.

In August 1961, 92 live fish were observed downstream from the hatchery, and in September, 4 live fish, 3 dead fish, and 12 redds were counted in this area. Also in September, 58 redds and 15 live and 5 dead salmon were found upstream from the hatchery.

It has been apparent from spawning ground surveys in Wind River that after passing Shipperd Falls many of the fish utilize the excellent spawning areas available to them. Many of the fish remain throughout the summer months in the deep pools of the canyon area downstream from the hatchery. Others either enter the concrete holding pond or utilize the area upstream. Normally, migration past the hatchery is not possible during the low flow period of summer and early fall. During this period practically all Wind River water is directed through the hatchery. This results in a nearly dry stretch of river between the hatchery intake and the point where the water returns to the river, a distance of about three-quarters of a mile. If a freshet occurs just prior to spawning time, as it did in 1961, some fish move upstream and proceed past the hatchery outlet. A rack is not installed in Wind River to direct fish to the hatchery.

Spring chinook salmon counted at Shipperd Falls fishway, presumed to be from liberations of fingerlings at Carson hatchery in period 1955-61, are summarized in table 10.

Table 10.--Fingerling releases, adult returns, eggs collected, and calculated total eggs available, Wind River, Washington, 1955-61.

Brood year	Fingerlings released	Eggs collected from adults returning to hatchery pond	Shipperd Falls fishway count		
			Total	Females (calculated)[1]	Potential eggs[2]
	Number	Number	Number	Number	Number
1955	967,300		0		
1956	623,000		10		
1957	732,000		1		
1958	1,016,500		26		
1959	260,700	0	--		
1960	1,535,200	960,900[3]	854	473	1,655,500
1961		429,700	1,032	239	836,500

[1] Based on sex ratio of fish returning to Carson National Fish Hatchery and assuming no mortalities prior to natural spawning.
[2] Total eggs calculated at 3,500 per female.
[3] Does not include an estimated 59,500 eggs secured from 17 females transferred from Little White Salmon National Fish Hatchery in August 1960.

SUMMARY

1. The 10-year scheduled Wind River, Wash., spring chinook salmon transplantation study began in 1955, and the scheduled completion date for hauling adults from Bonneville Dam is 1965.

2. In the period 1955-61, 3,221 adult spring chinook salmon have been transferred from Bonneville Dam to Carson National Fish Hatchery at Carson, Wash.

3. In the period 1955-61, total mortalities directly attributed to the trapping and hauling operations have been seven fish. Mortalities recorded were only those fish that were dead on arrival at the hatchery.

4. Of the fish hauled from Bonneville Dam and held in the dirt pond, losses have varied from 30.2 percent in 1957 to 6.8 percent in 1961.

5. In the period 1955-61, 6,900,600 eggs were collected from adults hauled from Bonneville Dam, and losses by brood year from green egg stage to release as fingerlings have varied from 31.3 percent in 1956 to 15.4 percent in 1960.

6. Quantity of water through the dirt holding pond has varied from 11 to 19 c.f.s. Best results have been obtained using a flow of approximately 14 c.f.s.

7. Water temperatures in the dirt holding pond have ranged from a minimum of 39° F. in 1957 and 1958 to a maximum of 61° F. in 1957.

8. Period of holding adult spring chinook salmon in the dirt pond at Carson hatchery has varied from 139 days in 1956 to 191 days in 1957.

9. In period 1955-61, 4,206,100 fingerlings, resulting from artificial spawning of adults hauled from Bonneville Dam, have been released in Wind River.

10. In 1959, 1960, and 1961, 107, 552, and 609 fish, respectively, entered Carson concrete holding ponds. Of the 107 entering the pond in 1959, 2 were females, both of which died prior to spawning. In 1960, it

was calculated that 960,900 eggs were secured from the 331 females entering the pond. From the 140 females entering the pond in 1961, 429,700 eggs were obtained.

11. Of the 552 fish entering the Carson concrete holding pond in 1960, 46 (or 5.7 percent) died in the pond or trap, spawned in the pond, had diseased ovaries, or were killed in error during spawning operations. Of the 609 fish entering the Carson concrete holding pond in 1961, similar losses amounted to 59 (9.7 percent).

12. In 1960, 1,020,300 eggs were collected from adults returning to the hatchery, and from these eggs 872,700 fingerlings were released in the spring of 1962. In 1961, 429,700 eggs were collected, and the resulting fingerlings will be released in the spring of 1963.

13. Infection with acid-fast bacteria of adults hauled from Bonneville Dam has varied from 13.2 percent in 1957 to 0.2 percent in 1961.

14. Infection with acid-fast bacteria of adults returning to Carson hatchery has varied from 8.1 percent in 1960 to 0.0 percent in 1959. Included in the examination were fish transferred from Carson hatchery.

15. In 1960, full-time counting at Shipperd Falls fishway was initiated, and 854 spring chinook salmon were recorded. In 1961, 1,032 were counted through the fishway facilities.

16. Spawning ground surveys have shown that many of the fish returning to Wind River are spawning naturally upstream and downstream from the hatchery.

ACKNOWLEDGMENTS

Bruce B. Cannady, assistant regional supervisor, Branch of Hatcheries, Donald F. Cairns and Robert J. McElrath, hatchery managers, and Charles Woods, assistant hatchery manager, Bureau of Sport Fisheries and Wildlife, cooperated in all phases of the study. Harlan E. Johnson, resident biologist, and his assistant, Richard G. Bigej, Little White Salmon National Fish Hatchery, contributed information regarding incidence and treatment of diseases of the spring chinook salmon handled at Carson hatchery.

Table A-1.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, Wind River, Washington, April 19 to September 23, 1955.

	April			May			June			July			August			September		
	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-
Date	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties
1				45	43	0	44	43	0	42	41	0	55	50	0	56	49	0
2				44	42	0	45	43	0	45	40	0	54	47	0	57	50	9
3				45	43	0	46	43	0	45	40	0	54	46	0	58	51	4
4				45	42	0	46	43	0	--	--	0	55	48	0	58	51	0
5				45	42	0	46	43	0	--	--	0	56	48	0	58	52	4
6				46	43	0	45	43	2	--	--	0	58	50	0	58	53	1
7				45	43	0	45	43	0	--	--	0	59	51	0	56	54	7
8				46	42	0	46	43	0	--	--	0	57	50	0	54	52	1
9				45	43	0	45	43	0	--	--	0	56	48	0	55	49	1
10				45	43	0	44	43	0	--	--	0	57	48	0	55	49	2
11				46	42	0	47	43	0	--	--	0	57	50	0	55	50	3
12				46	42	1	46	41	0	--	--	1	55	49	0	53	48	0
13				46	42	1	45	40	0	--	--	1	54	47	0	51	49	0
14				47	42	0	42	41	0	--	--	0	55	47	0	51	49	2
15				46	42	0	43	41	0	--	--	0	56	48	0	49	47	0
16				46	42	0	44	40	0	--	--	0	56	49	0	50	47	1
17				46	43	0	44	41	0	--	--	0	56	48	0	50	46	2
18				44	43	0	43	41	0	52	44	0	57	49	0	50	45	2
19	43	40	0	45	43	0	46	40	0	53	44	0	58	50	0	51	46	0
20	44	42	0	45	43	0	46	41	0	54	46	0	57	50	0	50	48	3
21	45	43	0	46	43	0	46	41	0	55	47	2	55	48	2	48	44	1
22	44	43	0	44	43	0	44	41	0	55	47	0	55	48	0	48	43	0
23	44	43	0	45	43	0	44	41	0	49	47	3	55	48	3	50	46	1
24	45	42	0	45	43	0	43	40	0	52	44	1	54	48	1			
25	45	43	0	46	43	0	44	41	0	49	45	0	54	49	0			
26	44	43	0	46	43	0	44	41	0	53	44	0	53	46	0			
27	44	43	0	46	43	0	46	41	0	54	45	1	54	47	1			
28	44	43	0	46	43	0	43	41	0	55	46	4	55	48	4			
29	44	43	0	46	42	0	42	41	0	56	47	3	55	48	3			
30	45	43	0	45	43	0	43	41	0	55	49	2	56	50	2			
31				46	42	0				55	48	5	56	50	5			
Total			0			2			2			23			21			44

Table A-2.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, Wind River, Washington, May 4 to September 20, 1956.

	May			June			July			August			September		
	Water temp.		Mor-	Water temp.		Mor-	Water temp.		Mor-	Water temp.		Mor-	Water temp.		Mor-
Date	Max.	Min.	tali- ties	Max.	Min.	tali- ties	Max.	Min.	tali- ties	Max.	Min.	tali- ties	Max.	Min.	tali- ties
1				43	41	0	50	42	0	52	48	0	56	50	2
2				46	41	0	49	44	0	49	48	0	54	47	1
3				43	40	0	51	45	0	51	48	0	54	47	0
4	44	41	0	43	40	0	50	44	0	55	47	1	50	46	1
5	45	41	0	42	40	0	49	46	0	56	48	0	50	43	3
6	44	40	0	45	41	0	52	45	0	57	49	0	50	44	0
7	44	40	0	43	41	0	54	45	0	57	49	0	52	46	2
8	43	40	0	45	41	0	52	46	0	57	49	0	52	46	2
9	46	41	0	42	41	0	54	48	0	58	50	0	48	46	3
10	44	41	0	43	40	0	54	48	0	56	50	0	50	47	1
11	44	40	0	46	40	0	51	48	0	58	50	0	50	47	1
12	45	40	0	47	40	0	56	47	1	59	50	0	50	44	0
13	45	39	0	45	41	0	54	49	0	59	52	3	51	44	6
14	47	41	0	43	41	0	52	48	0	59	52	0	51	45	1
15	45	40	0	43	40	0	51	45	0	59	52	0	52	46	0
16	46	40	0	44	41	0	55	46	0	56	52	2	52	46	1
17	47	40	0	46	40	0	57	48	0	57	49	2	52	47	0
18	47	40	0	45	40	0	54	48	0	58	50	0	52	47	0
19	47	40	0	43	41	0	60	51	0	59	51	2	52	48	1
20	46	40	0	44	40	0	60	53	0	60	52	15	50	43	0
21	47	40	0	46	41	0	60	52	0	60	52	1			
22	47	40	0	45	41	0	58	51	0	59	53	3			
23	44	41	0	46	41	0	60	51	0	59	53	4			
24	46	41	0	45	40	0	60	52	0	57	54	0			
25	47	40	0	46	40	0	60	52	0	53	51	1			
26	42	40	0	47	40	0	58	50	1	51	50	2			
27	43	40	0	53	41	0	57	50	0	53	50	1			
28	47	40	0	52	44	1	57	48	0	55	49	3			
29	47	40	0	50	43	0	53	48	0	52	50	2			
30	47	40	0	49	43	0	57	48	0	55	47	2			
31	44	41	0				56	48	0	56	49	2			
Total			0			1			2			46			25

Table A-3.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, Wind River, Washington, April 22 to September 29, 1957.

	April			May			June			July			August			September		
	Water temp.		Mor-	Water temp.		Mor-	Water temp.		Mor-	Water temp.		Mor-	Water temp.		Mor-	Water temp.		Mor-
Date	Max.	Min.	tali- ties	Max.	Min.	tali- ties	Max.	Min.	tali- ties	Max.	Min.	tali- ties	Max.	Min.	tali- ties	Max.	Min.	tali- ties
1				44	42	0	49	42	0	46	41	0	--	--	1	56	48	0
2				43	41	0	48	42	0	48	41	0	--	--	0	57	49	4
3				47	40	1	48	41	0	49	41	0	--	--	0	57	49	0
4				48	41	0	49	41	0	49	42	0	--	--	0	--	--	0
5				46	41	0	47	42	0	50	42	0	57	51	1	--	--	3
6				47	41	0	45	42	0	47	42	0	53	51	0	--	--	1
7				48	41	0	44	42	0	48	41	0	55	50	0	--	--	3
8				43	42	0	46	42	0	49	42	0	56	52	3	57	50	2
9				--	--	0	47	41	0	48	43	0	59	51	2	53	48	0
10				--	--	0	48	41	0	--	--	0	55	52	2	54	46	0
11				--	--	0	45	42	0	--	--	0	56	51	1	53	46	0
12				--	--	0	45	42	0	--	--	0	57	49	0	53	45	0
13				--	--	0	44	42	0	--	--	0	56	49	0	--	--	5
14				--	--	0	45	42	0	44	42	0	58	49	0	--	--	0
15				--	--	0	47	42	0	46	41	0	59	55	0	--	--	0
16				--	--	0	49	41	0	54	41	0	60	51	0	--	--	2
17				--	--	0	46	42	0	54	48	1	60	51	0	55	47	7
18				--	--	0	49	42	0	58	47	0	61	51	0	51	45	0
19				--	--	0	48	42	0	60	50	0	60	53	8	50	44	1
20				45	41	0	46	42	0	60	51	0	59	51	2	51	44	8
21				43	41	0	46	41	0	61	52	0	58	49	0	51	44	0
22	45	39	0	44	41	1	49	41	0	58	52	0	58	49	3	52	44	0
23	44	41	0	44	42	0	48	42	0	58	52	0	58	50	0	52	44	0
24	43	41	0	47	41	0	48	41	0	60	49	0	55	50	4	49	44	0
25	43	41	0	48	41	0	48	41	0	59	50	0	54	47	2	45	43	0
26	46	41	1	48	41	0	46	43	0	59	53	2	55	46	2	45	43	0
27	48	41	0	48	41	0	49	43	1	--	--	0	54	47	4	--	--	0
28	48	41	0	48	41	0	47	42	0	--	--	0	54	46	1	49	42	0
29	53	41	0	49	41	0	45	42	0	--	--	0	55	47	5	48	43	0
30	57	41	0	49	42	0	48	41	0	--	--	0	55	49	5	--	--	0
31				49	42	0				--	--	0	56	48	4			
Total			1			2			1			3			50			36

Table A-4.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, Wind River, Washington, May 9 to October 7, 1958.

Date	May			June			July			August			September			October		
	Water temp.		Mortalities	Water temp.		Mortalities	Water temp.		Mortalities	Water temp.		Mortalities	Water temp.		Mortalities	Water temp.		Mortalities
	Max.	Min.		Max.	Min.		Max.	Min.		Max.	Min.		Max.	Min.		Max.	Min.	
1				46	40	0	48	40	0	56	48	0	54	49	0	49	42	0
2				44	40	0	47	41	0	56	48	0	52	46	0	50	42	0
3				43	41	0	48	41	0	54	48	0	49	45	6	50	42	0
4				47	40	0	48	41	0	54	46	0	53	45	10	49	42	0
5				46	40	0	49	41	0	55	47	0	52	44	3	49	42	0
6				43	40	0	49	41	0	56	47	1	54	47	0	47	42	0
7				46	41	0	48	42	0	54	49	0	55	47	2	45	43	0
8				46	41	0	48	41	0	56	48	0	53	48	21			
9	--	--	1	43	41	0	49	41	0	56	48	0	54	49	4			
10	46	40	0	43	41	0	49	42	0	57	48	1	52	48	6			
11	43	40	0	43	41	0	--	--	0	56	49	0	52	48	0			
12	44	40	0	43	41	0	49	42	0	56	47	0	50	47	0			
13	46	39	0	43	41	0	48	42	0	56	47	0	51	48	0			
14	46	40	0	48	41	0	49	41	0	58	48	0	51	48	0			
15	47	40	0	48	41	0	50	41	0	58	49	1	53	48	11			
16	47	40	0	48	41	0	51	42	0	56	50	0	49	47	0			
17	--	--	0	48	41	0	50	43	0	57	49	0	50	48	0			
18	--	--	0	49	41	0	53	46	0	56	49	0	51	46	0			
19	--	--	0	48	41	0	54	47	0	57	48	0	51	48	0			
20	--	--	0	48	42	0	54	46	0	58	48	0	50	45	0			
21	--	--	0	48	41	0	54	46	0	59	50	0	49	46	0			
22	--	--	0	49	41	0	55	47	0	57	50	0	50	45	0			
23	--	--	0	46	41	0	55	47	0	58	49	1	48	44	0			
24	--	--	0	42	41	0	56	48	0	58	49	0	47	43	0			
25	44	40	0	46	41	0	55	47	1	58	50	4	49	43	0			
26	43	40	0	47	41	0	56	48	0	56	49	2	50	42	0			
27	46	39	3	45	41	0	57	49	0	52	49	2	50	42	0			
28	45	39	0	44	41	0	57	49	0	53	48	0	50	43	0			
29	46	39	1	44	41	0	58	49	0	50	49	7	49	43	0			
30	46	40	0	44	41	0	56	48	0	55	48	0	49	42	0			
31	45	40	0				56	48	0	55	47	0						
Total			5			0			1			20			63			0

Table A-5.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, Wind River, Washington, April 28 to September 22, 1959.

	April			May			June			July			August			September		
	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-
Date	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties
1				46	42	0	49	42	0	49	42	0	56	48	0	54	47	1
2				45	41	0	48	43	0	45	43	0	54	47	0	55	47	1
3				45	41	0	46	43	0	46	42	0	55	46	0	51	48	1
4				43	41	0	45	42	0	48	42	0	52	47	0	50	48	0
5				45	41	0	46	43	0	46	43	0	55	47	0	49	48	0
6				47	40	0	46	42	0	45	42	0	55	47	0	49	48	0
7				48	41	0	45	42	2	46	43	0	56	47	0	50	48	0
8				46	42	0	45	42	0	47	42	0	56	48	0	52	47	0
9				45	41	0	45	42	0	50	42	0	56	48	0	52	45	2
10				45	41	0	47	42	0	50	43	0	55	48	1	52	46	2
11				48	41	0	46	42	0	50	43	0	53	48	0	52	48	0
12				49	41	0	46	43	0	49	43	0	52	49	0	52	46	0
13				48	42	0	48	42	0	50	43	0	55	47	0	51	46	0
14				44	43	0	45	42	0	50	43	0	55	48	0	50	47	0
15				45	42	0	49	41	0	50	43	0	56	48	0	50	48	0
16				46	42	0	44	42	0	51	43	0	53	48	0	51	47	1
17				45	42	0	45	42	0	51	43	0	51	49	0	51	45	0
18				45	42	0	49	42	0	51	43	0	52	48	0	48	47	0
19				47	42	0	50	42	0	51	43	0	54	47	1	48	46	0
20				46	41	0	48	43	0	51	43	0	53	47	0	47	46	0
21				46	41	0	49	42	0	51	44	2	51	49	0	48	46	0
22				49	42	0	49	42	0	54	44	0	52	49	0	50	45	0
23				49	42	0	--	--	0	51	46	0	55	47	0			
24				44	42	0	--	--	0	54	47	0	56	48	0			
25				45	42	0	--	--	0	55	46	0	56	48	1			
26				46	42	1	--	--	0	55	47	0	51	49	0			
27				46	42	0	47	42	0	51	46	0	50	49	0			
28	43	42	0	46	42	0	46	42	0	53	46	0	53	48	0			
29	43	42	0	48	42	0	48	42	0	54	46	0	54	47	0			
30	44	42	0	49	42	0	49	42	0	55	46	0	54	46	0			
31				49	42	0				56	47	0	51	49	2			
Total			0			1			2			2			5			8

Table A-6.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, Wind River, Washington, April 26 to September 27, 1960.

	April			May			June			July			August			September		
	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-
Date	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties
1				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
2				--	--	0	--	--	0	--	--	0	--	--	0	--	--	4
3				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
4				--	--	0	--	--	0	--	--	0	--	--	2	--	--	0
5				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
6				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
7				--	--	0	--	--	0	--	--	0	--	--	0	--	--	13
8				--	--	0	--	--	0	--	--	0	--	--	1	--	--	4
9				--	--	0	--	--	0	--	--	0	--	--	0	--	--	1
10				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
11				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
12				--	--	0	--	--	0	--	--	0	--	--	0	--	--	25
13				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
14				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
15				--	--	0	--	--	0	--	--	0	--	--	0	--	--	1
16				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
17				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
18				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
19				--	--	0	--	--	1	--	--	0	--	--	0	--	--	0
20				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
21				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
22				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
23				--	--	0	--	--	1	--	--	0	--	--	0	--	--	0
24				--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
25				--	--	0	--	--	0	--	--	0	--	--	1	--	--	0
26	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
27	--	--	0	--	--	0	--	--	0	--	--	1	--	--	0	--	--	2
28	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0			
29	--	--	0	--	--	0	--	--	0	--	--	0	--	--	2			
30	--	--	0	--	--	0	--	--	0	--	--	0	--	--	1			
31				--	--	0				--	--	0	--	--	0			
Total			0			0			2			1			7			50

Table A-7.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in dirt holding pond, Carson National Fish Hatchery, Wind River, Washington, April 13 to October 1, 1961.

	April			May			June			July			August			September			October		
	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-
Date	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties
1				44	42	0	50	42	1	49	42	0	53	46	1	48	46	0	49	43	0
2				44	42	0	49	42	0	49	42	0	54	46	0	48	46	0			
3				44	42	0	49	43	0	49	42	0	54	47	0	51	45	0			
4				44	41	0	49	42	0	49	43	0	53	47	0	52	45	0			
5				44	42	0	47	42	0	45	43	0	53	48	0	50	45	0			
6				44	42	0	43	42	0	47	42	0	53	46	0	51	44	3			
7				45	42	0	47	42	0	49	42	0	54	46	0	51	45	0			
8				45	42	0	46	42	0	50	42	0	53	46	0	50	44	0			
9				44	42	0	44	42	0	50	42	0	53	46	0	51	45	0			
10				44	42	0	48	42	0	50	42	0	53	46	0	51	45	0			
11				46	42	1	44	42	0	51	43	0	53	48	0	51	45	0			
12				46	42	0	48	42	0	53	43	0	53	48	0	50	44	0			
13	43	41	0	45	42	0	49	42	0	52	46	0	53	47	0	51	44	0			
14	44	41	0	45	42	0	49	42	0	53	46	0	53	48	0	51	45	0			
15	47	41	0	47	42	0	50	42	0	52	46	0	50	46	0	47	45	0			
16	46	41	0	46	42	0	50	43	0	48	45	0	51	45	0	49	46	0			
17	44	42	0	46	42	0	50	43	0	51	45	0	52	44	1	50	44	0			
18	43	41	0	49	42	0	50	43	0	52	45	0	50	45	0	50	45	0			
19	43	40	0	49	42	1	49	42	1	52	45	0	52	45	0	50	44	0			
20	43	40	0	44	42	0	48	42	0	52	45	0	52	45	0	48	45	0			
21	43	42	0	45	42	0	49	42	0	53	46	0	55	45	0	49	44	0			
22	42	41	0	46	42	0	49	42	1	52	46	0	55	48	0	49	43	0			
23	43	41	0	46	42	0	50	42	0	51	46	0	54	48	0	49	43	0			
24	45	42	0	48	41	0	50	42	0	51	45	0	52	47	0	49	43	0			
25	44	41	0	49	42	0	49	42	0	52	45	0	53	46	0	50	43	13			
26	46	41	0	44	42	0	48	42	0	53	45	0	51	47	1	49	43	0			
27	46	41	0	47	42	0	48	42	0	52	46	0	54	47	0	49	43	0			
28	47	42	0	47	41	0	47	42	0	51	46	0	54	47	0	46	44	0			
29	43	42	0	47	42	0	45	42	0	52	45	0	54	47	0	47	43	0			
30	44	42	0	45	42	0	49	42	0	53	45	0	53	47	0	46	43	0			
31				49	42	0				53	46	0	52	47	0						
Total			0			2			3			0			3			16			0

Table A-8.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in concrete holding pond, Carson National Fish Hatchery, Wind River, Washington, May 5 to September 22, 1960.

	May			June			July			August			September		
	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-
Date	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties
1				--	--	0	--	--	0	--	--	0	--	--	0
2				--	--	0	--	--	0	--	--	0	--	--	0
3				--	--	0	--	--	0	--	--	1	--	--	0
4				--	--	0	--	--	0	--	--	0	--	--	0
5	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
6	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
7	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
8	--	--	0	--	--	0	--	--	1	--	--	0	--	--	2
9	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
10	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
11	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
12	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
13	--	--	0	--	--	0	--	--	0	--	--	0	--	--	2
14	--	--	0	--	--	0	--	--	0	--	--	0	--	--	3
15	--	--	0	--	--	0	--	--	2	--	--	0	--	--	0
16	--	--	0	--	--	0	--	--	0	--	--	2	--	--	0
17	--	--	0	--	--	0	--	--	0	--	--	1	--	--	0
18	--	--	0	--	--	0	--	--	0	--	--	1	--	--	0
19	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
20	--	--	0	--	--	0	--	--	0	--	--	0	--	--	0
21	--	--	0	--	--	0	--	--	1	--	--	0	--	--	0
22	--	--	0	--	--	0	--	--	0	--	--	2	--	--	1
23	--	--	0	--	--	0	--	--	0	--	--	0			
24	--	--	0	--	--	0	--	--	0	--	--	3			
25	--	--	0	--	--	0	--	--	1	--	--	0			
26	--	--	0	--	--	0	--	--	1	--	--	0			
27	--	--	0	--	--	0	--	--	0	--	--	0			
28	--	--	0	--	--	0	--	--	0	--	--	0			
29	--	--	0	--	--	0	--	--	0	--	--	4			
30	--	--	0	--	--	0	--	--	0	--	--	4			
31	--	--	0				--	--	0	--	--	0			
Total			0			0			6			18			8

Table A-9.--Daily maximum and minimum water temperatures (degrees F.), and mortalities (number of fish) of adult spring chinook salmon held in concrete holding pond, Carson National Fish Hatchery, Wind River, Washington, April 21 to September 20, 1961.

	April			May			June			July			August			September		
	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-	Water temp.		Mor-tali-
Date	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties	Max.	Min.	ties
1				44	42	0	52	44	0	50	45	0	--	--	1	50	48	0
2				44	42	0	51	45	0	51	45	0	--	--	0	48	47	0
3				43	42	0	52	46	0	51	45	0	--	--	0	50	46	0
4				43	41	0	51	45	0	51	46	0	--	--	0	51	47	0
5				43	41	0	49	45	0	47	46	0	--	--	0	52	46	2
6				43	42	0	46	45	0	48	44	0	--	--	0	51	46	0
7				44	42	0	50	44	0	49	44	0	--	--	0	50	46	1
8				45	42	0	48	44	0	50	44	0	--	--	1	49	45	0
9				44	43	0	46	44	0	51	45	0	--	--	0	50	45	0
10				44	42	0	50	43	0	51	45	0	--	--	0	50	46	0
11				46	42	0	47	45	0	52	46	0	--	--	0	50	46	28
12				46	42	0	51	44	0	52	46	0	--	--	0	50	45	0
13				44	42	0	52	44	0	53	47	0	--	--	0	--	--	4
14				45	42	0	53	46	0	52	47	0	--	--	0	48	45	6
15				47	41	0	54	46	0	51	46	0	52	48	1	47	45	3
16				47	42	0	53	46	0	47	45	0	55	47	1	49	46	0
17				47	43	0	54	47	0	52	45	1	55	49	0	49	45	0
18				49	43	0	56	48	0	53	47	0	54	49	1	50	46	0
19				49	43	0	52	46	0	53	47	0	56	50	0	50	46	0
20				45	43	0	51	46	0	54	48	0	57	52	0	--	--	2
21	44	42	0	45	43	0	53	45	0	54	48	0	56	49	0			
22	42	42	0	46	43	0	51	45	0	54	48	0	56	50	2			
23	43	42	0	46	43	0	51	46	0	53	48	0	56	50	0			
24	45	42	0	48	42	0	51	45	0	53	47	0	52	48	1			
25	44	42	0	49	43	0	52	45	0	54	47	0	51	47	0			
26	--	--	0	45	44	0	50	46	0	53	48	0	50	48	0			
27	--	--	0	47	43	0	49	45	0	52	47	0	52	47	0			
28	46	43	0	47	42	0	48	45	0	53	46	0	52	47	0			
29	43	42	0	48	44	0	46	44	0	53	46	0	52	47	0			
30	44	42	0	46	44	0	49	44	0	53	47	0	53	48	0			
31				49	43	0				--	--	0	51	49	0			
Total			0			0			0			1			8			46

MS #1244

GPO 936-687

Created in 1849, the Department of the Interior--America's Department of Natural Resources--is concerned with the management, conservation, and development of the Nation's water, fish, wildlife, mineral, forest, and park and recreational resources. It also has major responsibilities for Indian and Territorial affairs.

As the Nation's principal conservation agency, the Department works to assure that nonrenewable resources are developed and used wisely, that park and recreational resources are conserved for the future, and that renewable resources make their full contribution to the progress, prosperity, and security of the United States--now and in the future.